CLAIMS

1. An ink jet printhead comprising:

a plurality of nozzles;

a plurality of nozzle chambers each corresponding to a respective nozzle; and

a plurality of heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers, wherein

each heater element is arranged for being in thermal contact with a bubble forming liquid, and

each heater element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble therein thereby to cause the ejection of a drop of an ejectable liquid through the nozzle corresponding to the chamber in which that heater element is disposed.

2. The printhead of claim 1 being configured to support the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle.

3. The printhead of claim 1 wherein the bubble forming liquid and the ejectable liquid are of a common body of liquid.

4. The printhead of claim 1 being configured to print on a page and to be a page-width printhead.

5. The printhead of claim 1 wherein the heater elements have been formed by a lithographic process, each heater element within each chamber having been formed by at least one step of said lithographic process, the at least one step for forming each heater element within each chamber being distinct from the at least one step for forming each other heater element within that chamber.

6. The printhead of claim 1 wherein the heater elements in each chamber are differently sized to one another.

7. The printhead of claim 1 wherein the heater elements in each chamber are sized such that said printhead is configured to eject drops of the ejectable liquid which drops are of different volumes to one another, the respective volumes being binary weighted relative to one another.

8. The printhead of claim 1 wherein each heater element is in the form of a suspended beam, arranged for being suspended over at least a portion of the bubble forming liquid so as to be in thermal contact therewith.

9. The printhead of claim 1 wherein each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater element to heat that heater element sufficiently to form a said bubble in the bubble forming liquid thereby to cause the ejection of a said drop.

10. The printhead of claim 1 configured to receive a supply of the ejectable liquid at an ambient temperature, wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of a said drop is less than the energy required to heat a volume of said ejectable liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

11. The printhead of claim 1 comprising a substrate having a substrate surface, wherein each nozzle has a nozzle aperture opening through the substrate surface, and wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

12. The printhead of claim 1 wherein each heater element has two opposite sides and is configured such that a said gas bubble formed by that heater element is formed at both of said sides of that heater element.

13. The printhead of claim 1 wherein the bubble which each heater element is configured to form is collapsible and has a point of collapse, and wherein each heater

element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

14. The printhead of claim 1 comprising a structure that is formed by chemical vapor deposition (CVD), said nozzles being incorporated on the structure.

15. The printhead of claim 1 comprising a structure which is less than 10 microns thick, said nozzles being incorporated on the structure.

16. The printhead of claim 1 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

17. The printhead of claim 1 wherein each heater element includes solid material and is configured for a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point, thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of a said drop.

18. The printhead of claim 1 wherein each heater element is substantially covered by a conformal protective coating, the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless.

19. A printer system incorporating a printhead, the printhead comprising:

a plurality of nozzles;

a plurality of nozzle chambers each corresponding to a respective nozzle; and

a plurality of heater elements being disposed within each chamber, the heater elements within each chamber being formed on different respective layers, wherein

each heater element is arranged for being in thermal contact with a bubble forming liquid, and

each heater element is configured to heat at least part of the bubble forming liquid to a temperature above its boiling point to form a gas bubble

therein thereby to cause the ejection of a drop of an ejectable liquid through the nozzle corresponding to the chamber in which that heater element is disposed.

20 The system of claim 19 being configured to support the bubble forming liquid in thermal contact with each said heater element, and to support the ejectable liquid adjacent each nozzle.

21. The system of claim 19 wherein the bubble forming liquid and the ejectable liquid are of a common body of liquid.

22. The system of claim 19 being configured to print on a page and to be a page-width printhead.

23. The system of claim 19 wherein the heater elements have been formed by a lithographic process, each heater element within each chamber having been formed by at least one step of said lithographic process, the at least one step for forming each heater element within each chamber being distinct from the at least one step for forming each other heater element within that chamber.

24. The system of claim 19 wherein the heater elements in each chamber are differently sized to one another.

25. The system of claim 19 wherein the heater elements in each chamber are sized such that said printhead is configured to eject drops of the ejectable liquid which drops are of different volumes to one another, the respective volumes being binary weighted relative to one another.

26. The system of claim 19 wherein each heater element is in the form of a suspended beam, arranged for being suspended over at least a portion of the bubble forming liquid so as to be in thermal contact therewith.

27. The system of claim 19 wherein each heater element is configured such that an actuation energy of less than 500 nanojoules (nJ) is required to be applied to that heater element to heat that heater element sufficiently to form a said bubble in the bubble forming liquid thereby to cause the ejection of a said drop.

28. The system of claim 19, wherein the printhead is configured to receive a supply of the ejectable liquid at an ambient temperature, and wherein each heater element is configured such that the energy required to be applied thereto to heat said part to cause the ejection of a said drop is less than the energy required to heat a volume of said ejectable liquid equal to the volume of the said drop, from a temperature equal to said ambient temperature to said boiling point.

29. The system of claim 19 comprising a substrate having a substrate surface, wherein each nozzle has a nozzle aperture opening through the substrate surface, and wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

30. The system of claim 19 wherein each heater element has two opposite sides and is configured such that a said gas bubble formed by that heater element is formed at both of said sides of that heater element.

31. The system of claim 19 wherein the bubble which each heater element is configured to form is collapsible and has a point of collapse, and wherein each heater element is configured such that the point of collapse of a bubble formed thereby is spaced from that heater element.

32. The system of claim 19 comprising a structure that is formed by chemical vapor deposition (CVD), said nozzles being incorporated on the structure.

33. The system of claim 19 comprising a structure which is less than 10 microns thick, said nozzles being incorporated on the structure.

34. The system of claim 19 wherein each heater element is formed of solid material more than 90% of which, by atomic proportion, is constituted by at least one periodic element having an atomic number below 50.

35. The system of claim 19 wherein each heater element includes solid material and is configured for a mass of less than 10 nanograms of the solid material of that heater element to be heated to a temperature above said boiling point, thereby to heat said part of the bubble forming liquid to a temperature above said boiling point to cause the ejection of a said drop.

36. The system of claim 19 wherein each heater element is substantially covered by a conformal protective coating, the coating of each heater element having been applied substantially to all sides of the heater element simultaneously such that the coating is seamless.

37. A method of ejecting a drop of an ejectable liquid from a printhead, wherein the printhead comprises a plurality of nozzles, the method comprising the steps of:

providing the printhead wherein the printhead has a plurality of nozzle chambers each chamber corresponding to a respective nozzle;

forming a plurality of heater elements in each chamber, such that the heater elements in each chamber are formed on different respective layers to one another;

heating at least one heater element in a said chamber so as to heat at least part of a bubble forming liquid which is in thermal contact with the at least one heated heater element to a temperature above the boiling point of the bubble forming liquid;

generating a gas bubble in the bubble forming liquid by said step of heating; and

causing the drop of ejectable liquid to be ejected through the nozzle corresponding to the chamber in which the at least one heated heater element is disposed, by said step of generating a gas bubble.

38. The method of claim 37 comprising, before said step of heating, the steps of:

disposing the bubble forming liquid in thermal contact with the heater elements; and

disposing the ejectable liquid adjacent the nozzles.

39. The method of claim 37 wherein the bubble forming liquid and the ejectable liquid are of a common body of liquid.

40. The method of claim 37 wherein, in the step of forming a plurality of heater elements, the heater elements are formed by a lithographic process.

41. The method of claim 40 wherein each heater element within each chamber is formed by at least one step of said lithographic process, the at least one step for forming each heater element within each chamber being distinct from the at least one step for forming each other heater element within that chamber.

42. The method of claim 37 wherein, in the step of forming a plurality of heater elements, the heater elements in each chamber are formed so as to be differently sized to one another.

43. The method of claim 37 wherein, in the step of forming a plurality of heater elements, the heater elements in each chamber are sized such that said printhead is configured to eject drops of the ejectable liquid wherein the drops are of different volumes to one another, the volumes of the differently sized drops being binary weighted relative to one another.

44. The method of claim 43 wherein, in the step of causing the drop of ejectable liquid to be ejected, a plurality of said drops are caused to be ejected through the nozzle corresponding to the chamber in which the at least one heated heater element is disposed, the drops being binary weighted relative to one another.

45. The method claim 37 wherein each heater element is in the form of a suspended beam, the method further comprising, prior to the step of heating at least one heater element, the step of disposing the bubble forming liquid such that the heater elements are positioned above, and in thermal contact with, at least a portion of the bubble forming liquid.

46. The method claim 37 wherein the step of heating at least one heater element is effected by applying an actuation energy of less than 500nJ to each such heater element.

47. The method of claim 37, comprising, prior to the step of heating at least one heater element, the step of receiving a supply of the ejectable liquid, at an ambient temperature, to the printhead, wherein the step of heating is effected by applying heat energy to each such heater element, wherein said applied heat energy is less than the energy required to heat a volume of said ejectable liquid equal to the volume of said drop, from a temperature equal to said ambient temperature to said boiling point.

48. The method of claim 37 wherein, in the step of providing the printhead, the printhead includes a substrate having a substrate surface, and each nozzle has a nozzle aperture opening through the substrate surface, wherein the areal density of the nozzles relative to the substrate surface exceeds 10,000 nozzles per square cm of substrate surface.

49. The method claim 37 wherein each heater element has two opposite sides and wherein, in the step of generating a gas bubble, the bubble is generated at both of said sides of each heated heater element.

50. The method claim 37 wherein, in the step of generating a gas bubble, the generated bubble is collapsible and has a point of collapse, and is generated such that the point of collapse is spaced from the at least one heated heater element.

51. The method claim 37 wherein the step of providing the printhead includes forming a structure by chemical vapor deposition (CVD), the structure incorporating the nozzles thereon.

52. The method claim 37 wherein, in the step of providing the printhead, the printhead has a structure which is less that 10 microns thick and which incorporates said nozzles.

53. The method claim 37 wherein, in the step of forming a plurality of heater elements, each heater element is formed of solid material more than 90% of which, by atomic

proportion, is constituted by at least one periodic element having an atomic number below 50.

54. The method claim 37 wherein each heater element includes solid material and wherein the step of heating at least one heater element includes heating a mass of less than 10 nanograms of the solid material of each such heater element to a temperature above said boiling point.

55. The method claim 37 wherein the step of forming a plurality of heater elements includes applying to each heater element, substantially to all sides thereof simultaneously, a conformal protective coating such that the coating is seamless.